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Soil Conservation

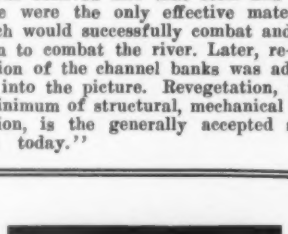
SOIL CONSERVATION SERVICE • U. S. DEPARTMENT OF AGRICULTURE

SOLID FOOTING

25 Years Ago

"Grass is man's most powerful ally in soil and moisture conservation . . . Adapated plants and basic facts of practices are now known. At present, one of the most challenging aspects . . . involves the determination of species and proper management of plants especially adapted for use on the millions of acres where climatic and edaphic factors are less favorable for plant establishment . . ."

"To keep the farm land out of the river and the river out of the farm land is the immediate objective of all treatment involving bank protection on the upper Gila River. . . In those early days it was believed also that steel and concrete were the only effective materials which would successfully combat and remain to combat the river. Later, re-vegetation of the channel banks was admitted into the picture. Revegetation, with a minimum of structural, mechanical protection, is the generally accepted solution today."



COVER PICTURE—A soil conservation technician views aerial photographs through a stereoscope as he makes a land treatment plan. In such ways as this, modern surveying and mapping procedures speed the work of today's conservation workers.—Photo by Justus V. Baum, Jr.

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Soil Conservation

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Conservation Technology

Modern Methods Keep Pace With Today's Fast-Changing Agriculture

By Donald A. Williams

ANY scientific program—soil and water conservation included—is only as sound as the technology on which it is based. Effective technology is fluid, because the conditions and needs of a program are constantly changing.

Agriculture especially is in a rapid state of change. Larger farms, increased mechanization, more emphasis on management skills, and shifting of farmland to nonagricultural uses all call for increased and redirected technical skills.

Today's fast-moving soil and water conservation movement has a firm foundation of conservation technology. Land owners and operators, contractors, and Soil Conservation Service and Agricultural Research Service specialists continue to devise and try out new, improved conservation techniques.

Refinements being made in terracing are one example of steadily advancing technology. Farmers and the conservationists and researchers assisting them are modernizing terrace design, construction, and use to increase the benefits of terracing while eliminating its drawbacks. Parallel and "push-up" terracing systems have resulted that eliminate the bothersome point rows and uneven and inadequate spacing that made terraces difficult to farm.

These improvements, in combination with increased know-how in related cropping systems—minimum tillage, crop-residue mulches, soil-improving rotations—are allowing more efficient, profitable farming and more effectively reducing runoff and erosion.

Improved techniques in classification and interpretation of soils are enabling us to get a better picture faster of our Nation's soils. The information is being used increasingly to prevent costly land use mistakes both in and out of agriculture.

Constant improvements are being made in the machines that do all kinds of conservation jobs—tree planting, ditch lining, and earthmoving for many purposes. More powerful modern equipment has made possible a rapid increase in earthmoving.

Improvements in design and installation of structures for erosion control and flood prevention are resulting in better, safer structures at lower cost.

Better plant materials are being developed, along with better skills for adapting, planting, and maintaining the stock used.

Technological improvements are useless, however, unless they are put on the land. How quickly a soil conservation district adapts soil conservation measures to new technology is a reflection of the modernism or archaism of the conservationist assisting that district.

The Soil Conservation Service can be no better than the combined skills of its work unit people. They must use up-to-date methods and techniques and recommend up-to-date conservation treatments to cooperators. A terrace that fitted the land and farming operations of the days of the two-row cultivator is as out of place as a steam threshing rig in today's agriculture.

SCS is making a concerted effort to keep its conservationists up to date. It is placing new emphasis on their education and personal qualifications. It seeks new employees who are trained in fields such as outdoor recreation, wildlife management, forestry, and range management. Also, SCS seeks people who are able to deal effectively with both rural and urban people.

SCS employees are urged to get further academic training while on the job. An encouraging number receive advanced degrees each year. The SCS also works with colleges and universities in revising their curriculums to keep pace with the needs of modern conservationists.

Qualifications, training, and technical standards are only guides, however. In final analysis it is the ingenuity and enthusiasm with which the local conservationist adapts new developments and techniques to local problems and situations that gets modern conservation on the land. These qualities must be encouraged; we need a 1964 program in 1964.

Resource protection and development will continue to depend upon a sound, improving technology. Increasing interdependence of urban and rural people and the pressing needs for better economic opportunities for rural communities call for resource development on a still broader scale in the future. We must keep our technology moving to match it.

Crownvetch Rewards Skill, Care in District Seed Plot

By George P. Thorburn and Virgil B. Hawk

A YIELD of 466 pounds of clean seed per acre of a new plant—Emerald crownvetch—was like a gold strike for the Keokuk County Farm in southeastern Iowa in 1963.

The yield was from the Keokuk County Soil Conservation District seed increase field, which is the latest addition to conservation activities of the county farm. This farm has become a model for outstanding results in soil and water conservation under the guidance of Martin Holm, custodian, and John Anderson, farm operator.

After a new plant, such as Emerald crownvetch, has been thoroughly tested and has proved its worth under field conditions, the next step is to produce seed for wide use.

In spring of 1961, the Soil Conservation Service furnished 20 pounds of foundation seed of Emerald crownvetch to the Keokuk County district from production at the Elsberry Plant Materials Center. A seed increase agreement was set up between the district and the Keokuk County Board of Supervisors who operate the county farm under a conservation farm plan.

Mixture of Emerald crownvetch unhulled seed and a large bulk of green leaves obtained by direct combine harvest in 1962.

Under supervision of SCS technicians, the seed was treated with a fungicide, inoculated, and broadcast with a hand seeder on a 1-acre field of Clinton silt loam in April 1961. The seedbed was on cornstalk ground with a heavy residue which was tandem disked four times. Fertilizer was broadcast and the seed covered by a double harrowing. Weed control measures were applied, including a post-emergence herbicide to eliminate annual grasses.

The stand obtained the first year appeared to be quite thin and spotty, possibly because of the bunches of cornstalk residue.

In 1962, since the growth was not heavy or thick, a direct combine harvest was tried and the unhulled seed and green leaves obtained were carefully dried to prevent spoilage. Only 19 pounds of clean seed was realized. The germination was 72 percent, including hard seed, but many seeds were shriveled and immature.

In 1963, plant growth and seed production on the original acre were excellent. The ground was completely covered by plants that reached a height of about 4 feet and were a mass of pinkish blooms. Like birdsfoot trefoil, Emerald crownvetch blooms, forms pods, and matures seed continuously for several weeks. Its pods, when ripe, become dry and brittle and break off easily. They do not pop open like birdsfoot trefoil, but break into sections between the seeds.

Late in July, the crownvetch was mowed and laid out in windrows. Since ripe pods break off easily, handling of the material had to be kept to a minimum. After drying for 5 days, it was threshed with a combine with pickup attachment. This resulted in seed free from green leaves and dry enough to be stored. After hulling, scarifying, and cleaning, the yield was 466 pounds of seed with a purity of 99.59 percent, no noxious weeds, and a germination test of 88 percent, including 40 percent hard seed and 5 percent firm seed. This is a higher test than required for certified crownvetch seed.

George Thorburn checks the Keokuk County SCD seed increase field of Emerald crownvetch at the late bloom stage in 1963.

The district's share of the seed will be used to establish new seed increase fields in the Keokuk and Lee County soil conservation districts. The balance is being sold to district cooperators and highway erosion control contractors throughout Iowa for the stabilization of steep banks and critical erosion areas.

There is interest in the formation of an Emerald Crownvetch Seed Growers Association to foster stable supplies and marketing. In western Iowa, where birdsfoot trefoil may not be well adapted, there is interest in using crownvetch for pasture seedings.

The authors are work unit conservationist, Sigourney, and plant materials technician, Ames, both of the Soil Conservation Service, Iowa.

Conservationists Find Way to Irrigate Saline Soils to Grow Pasture Grasses

By Edward E. Thomas

DESERT, desperation, and despair.

So might the uninitiated tourist speeding along transcontinental highway US-80 in Trans-Pecos Texas view the flat, salt-laden countryside.

But farmers who understand the natural limitations of the area and use the information available to them from the Soil Conservation Service about soil-water-plant relationships can achieve success and satisfaction in the use of these difficult soils.

Such a farmer is James P. Goode, 2 miles west of Barstow in the Upper Pecos Soil Conservation District. After years of irrigating crops with the salty water available in the area, his fields had become so salty that even weed seeds refused to sprout and grow. SCS conservationists assisting the district helped him plan an irrigation and soil-management system that enabled him to establish bermudagrass on his cropland and provide needed grazing for his livestock.

Goode's problems were those normally encountered in desert regions: (1) The annual rainfall is less than 10 inches, making irrigation necessary for crop production; (2) soils contain much salt harmful to crop production; (3) irrigation water also contains harmful salts; (4) high temperatures and high salt content cause the fine-textured soils to form surface crusts that restrict plant emergence; and (5) the application of salty irrigation water builds increasing concentrations of salts harmful to crops.

An efficient plan for conservation irrigation of saline soils such as exist in the western part of the United States must take into account three major factors: (1) The salt tolerance of the crop to be grown; (2) the salinity of the irrigation water; and (3) the physical properties of the soil that permit or inhibit the necessary salinity balance for profitable crop production.

In order to appraise Goode's problems and opportunities, the SCS had to (1) map the soils on the farm, (2) determine the water-holding capacity, permeability, and other physical properties of the soil, (3) check the salt content of the soil and of the irrigation water, and (4) appraise the existing irrigation system and current methods of watering the crops.

The soil survey indicated that these were problem soils, especially with regard to movement of air and water.

The degree of salinity was determined in the field with a solubridge, an instrument that measures the electrical conductivity of the extract of soil samples saturated with distilled water. The results showed that it would be necessary to leach the soluble salts down and out of the root zone. Permeability measurements indicated that the soils could be leached. The gross irrigation water requirement for the crops to be grown, including that needed for leaching, was calculated.

This technical information was used to design and lay out a conservation irrigation system.

Goode's plan called for the orderly application of a combination of permanent and management-type practices. Goode entered into a Great Plains Conservation Program contract that provided financial assistance in applying some of the permanent con-

Conservation irrigation system makes possible good pasture on saline soil.

The author is area conservationist, Soil Conservation Service, Pecos, Tex.

Arno clay soil in the Pecos Valley contains high concentration of salts harmful to crops.

Salts rise to tops of lister ridges after irrigation; bermudagrass is planted in furrows where soil is less salty.

Coastal bermudagrass is spreading over crusted saline soil with aid of frequent irrigation to reduce salt.

servation practices.

The old irrigation system was reorganized by constructing stabilized earthen ditches, leveling 78 acres of land, and installing a level border irrigation system.

When the system was completed, the operator applied 18 inches of water to leach the soil of the accumulation of salts. He then sprigged the former cropland to Coastal bermudagrass, a salt-tolerant pasture grass. He irrigated the newly sprigged area on a 7-day schedule for 2 months until the grass was established. The short cycle of irrigation was needed to keep the moisture content of the soil high, to continue to leach out salts, and to reduce soil crusting and enable the grass to cover the ground more quickly.

Anhydrous ammonia fertilizer was applied in the first application of irrigation water and monthly thereafter. By adequate fertilization, proper irrigation, and a lot of hard work, Goode had the once bare and lifeless soil producing again.

The success of Goode's operation has resulted in many benefits. Good grazing for the livestock enterprises is evident. The grass has formed an excellent ground cover which has doubled the efficiency of leaching by the irrigation water.

This experience is not a rarity as might be expected. Farmers in the Upper Pecos district are solving many old problems that result in the mutual benefit of neighboring landowners. Through the efficient management and proper use of soils, water, and plants, thousands of acres of problem soils are being made to contribute to the financial well being of the area.

Alaska Earthquake Damages Ranches on Kodiak Island

The Alaska earthquake caused serious damage to ranches on Kodiak Island but had little effect on the Matanuska and Tanana valleys and the Kenai farming areas, State Conservationist William B. Oliver reports.

Total damage to 12 Kodiak ranches was estimated at $250,000 to $300,000. About 200 head of cattle were lost. Three houses, 4 or 5 barns, and a slaughter house were destroyed.

The earthquake caused no change in plans for soil surveys in Alaska this summer.

Wildlife Aid To Suisun District

The Suisun Soil Conservation District and the California Department of Fish and Game have signed a memorandum of understanding which provides for technical services to the district for development and maintenance of fish, game, and other wildlife resources through the district's land and water management program.

A wildlife management technician has been assigned to the district 2 days a week.

Carrying Capacity for Recreation Applies Basic Ideas in New Setting

By Frank C. Edminster

PLANNING recreation use of land presents soil conservationists with new problems that challenge their ingenuity and call into play background knowledge in many scientific fields.

One aspect of recreation planning now gaining recognition is that there are limits to the number of people that can be provided recreation by any tract of land. Conservationists seeking to define these limits make use of two biological concepts familiar to soil conservationists—"carrying capacity" and "saturation point."

Soil conservationists have long used the concept of carrying capacity in a variety of forms. Productivity of rangeland and tame pastures and their ability to support livestock and wildlife are essential considerations in grazing management. In wildlife management, different habitats are evaluated as to the numbers of different kinds of game birds and animals they will support. In woodland management, we speak of "cords per acre per year" that a site produces—a variation of the carrying capacity idea.

The other concept called "saturation point" is less generally known. Simply stated, the saturation point of a population is the level that a species never exceeds regardless of the quality of its environment. For example, the breeding population of ruffed grouse, a woodland game bird, is never more than 25 birds per 100 acres. This limit is set by the character of the species itself, rather than of the environment. It is a social factor, a limit of tolerance to its own kind—a sort of *social* carrying capacity.

The ideas of carrying capacity and saturation point both are important in developing recreation areas. Conservationists assisting landowners and groups will need to take *human* carrying capacities into account just as they do for animals and plants on land in other uses. However, since *Homo sapiens* is both a gregarious and a greatly variable species, there are both great tolerances and strict limitations that must be considered.

Carrying capacity of recreation areas for people is not determined by food supplies or by shelter, as is generally true with wild creatures. It may be determined by soil conditions. More often, it is decided by safety factors or by the tolerances of people for people —the saturation point idea. Let us take a couple of examples to illustrate.

Cottages for vacationers are to be built around a new lake. Septic tanks will be used for waste disposal. The spacing of the cottages, and hence the number of vacationers, will depend on the ability of the soil to dispose of sewage. If the soil is only marginally suited for septic tanks, the cottages will have to be widely spaced and the carrying capacity of the area for vacationers is low. If the soil is very suitable for infiltrating water and waste, the cottages can be close together and the carrying capacity is high. However, depending upon the *kind* of clientele, the intolerance of the vacationers for others of their kind may interpose a stricter limit than soil. Thus, cottages might need to be spaced wider than soil conditions would allow to satisfy the desires of people. Here the *social* carrying capacity sets the limit.

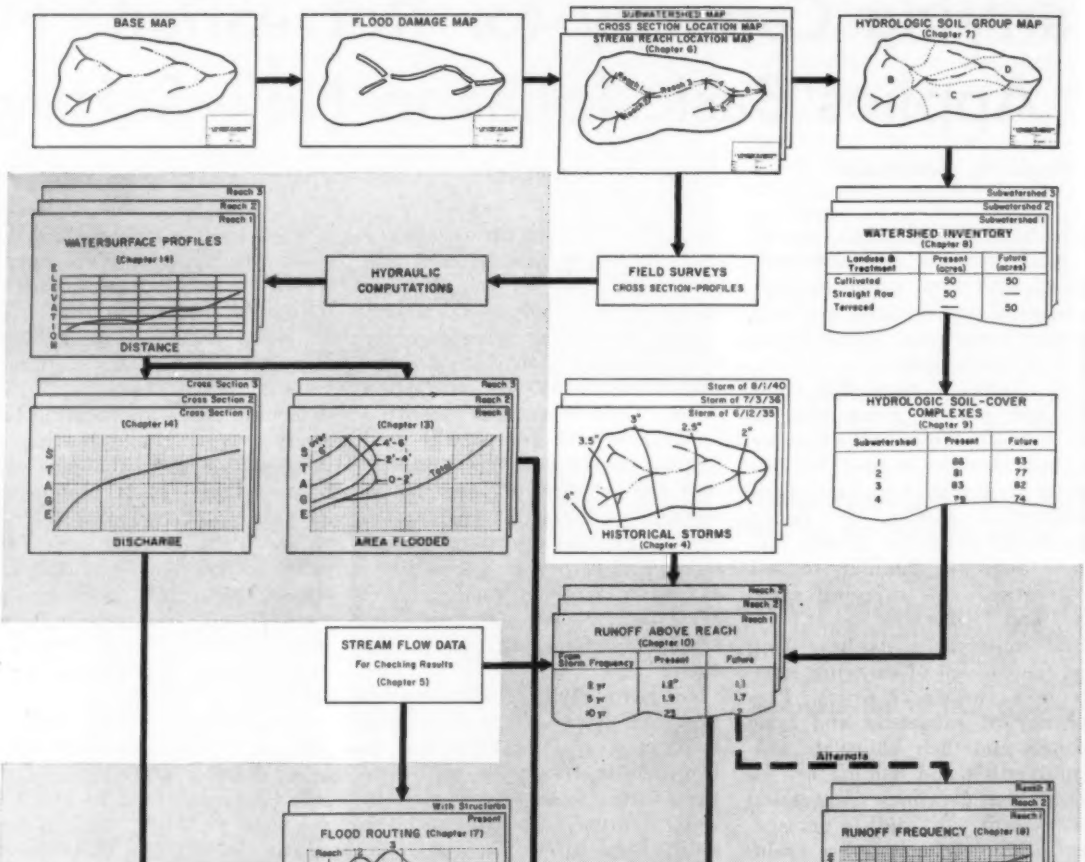
As a second example, take a swimming beach and boating lake. Since swimming and boating are incompatible uses, the lake must be zoned and each portion will have its own carrying capacity for its use. In both cases, *safety* is a prime factor. If only rowboats are allowed, there may be several per acre of water. If powerboats and water skiing are permitted, only about 1 boat per 5 acres can be tolerated.

Many more swimmers than boaters can be accommodated on an acre of water and shore. A normal tolerance would be about 400 per acre of beach. This is based on an assumption that there is twice as much water for swimming as beach for lolling, and that 70 to 85 percent of the "swimmers" are on the beach at any time.

The amount of space devoted to different activities times the carrying capacities gives the peak load of people for each kind of area. These figures are the basis for planning facilities. The marina will be designed to hold the allowable number of boats, the bathhouse to accommodate the swimmers. The car-parking area will be designed to limit the attendance to the number of people that can be accommodated for all activities.

Thus, conservationists will apply the ideas of carrying capacity and saturation point in planning recreation land use just as they have in other kinds of land use planning.

The author is assistant director, Plant Technology Division, Soil Conservation Service, Washington, D. C.



Hydrologic functions in planning a watershed project. This flow-chart indicates the scope and complexity of evaluating the physical features of a watershed and the effects of planned treatment. The steps in the shaded area can be performed by electronic computer in the program now being field tested. Most of the others are to obtain basic data required as input to the program.

Electronic Computers Join SCS Team In Planning for Watershed Protection

By H. O. Ogrosky

IT will take minutes for watershed planning specialists in the future to get information that formerly entailed weeks of tedious work. Why? The electronic computer is becoming a regular member of their team.

Soil Conservation Service engineers today are field testing the use of electronic computers in planning actual watersheds. The procedures now being used give quick answers to the crucial question of how much flood flows would be reduced by various combinations of channel works and floodwater-retarding structures. For a watershed with average conditions, after basic field data have been collected and programed according to standard instructions, the computer takes about 72 seconds to determine the effect of 18 retarding structures on the height of waterflow at 25 locations downstream after varying amounts of rainfall. The same computations performed manually might require a month or more of an engineer's time. The computer program can include data for as many as 60 structures and will compute the information for 120 locations on the stream.

The development of a watershed plan is a very complicated task. Planning specialists for each watershed must develop the most economical plan that will meet the objectives of the project sponsors. To do this they usually must prepare and evaluate several alternative plans. To determine which of the possible solutions is most economical, planners must consider many combinations of vegetative and structural controls. Although the planning team has wide latitude in devising plans, the end product must conform to a host of limitations.

There are natural or physical limitations, such as the climate and topography. There are legal limitations, such as the maximum allowable storage capacity of structures and the required benefit-cost relationship of the project. And there are limitations set by the amount of funds local sponsors can make available to carry out the work.

The use of computers makes it possible to get quantitative evaluations of many more combinations of measures than could be considered otherwise. The computer currently being used is capable of making 229,300 additions or subtractions per second. Certainly no practical team of human workers can match this. Information produced by the machine gives planners a wider choice in finding the plan that best fits the limitations of the project.

Machine computation, however, is not necessarily expected to reduce planning costs, but rather to produce better plans. The machine cost of making 10 evaluations on one watershed with varying rainfall volumes and durations and a varying number of structures and channel works is about $300. The time required to make this number of evaluations by manual calculation makes it impossible except for extremely critical or costly projects. The wider choice of alternatives offered by the use of computers results in a more efficient plan which in turn may reduce the overall cost of the project and make the watershed-protection dollar go farther.

An important feature of the SCS computer program is that field engineers can use it with very limited instructions. This is because both the input and output data are in a form and language familiar to them rather than in complicated code.

The full potential for the use of electronic computers to reduce the time of necessary mathematical work in conservation engineering cannot be realized at this time.

The evolution of the computer has been so fast that equipment often became obsolescent before it could be installed. Improvements are still being made, but it appears that the size and capacity of current models using tiny microcircuits should fulfill Service needs for some time to come.

It is quite safe to predict that SCS will find many additional uses for the new computers. The present computer program was designed to handle only the hydraulic and hydrologic aspects of watershed planning. It is, however, designed so that additional components of the planning process can be added to obtain a complete evaluation of proposed watershed projects in the future.

Scientists need not be worried about being replaced by computers in watershed planning. The machine must be fed reliable basic data if good results are to be obtained. Many kinds of basic data on physical conditions in a watershed must be obtained and the economic, social, and legal limitations of the project defined by competent professional workers before the computer can be programed to give its answers. It will make only the decisions that someone tells it to make. It is already clear, however, that computers can be used by SCS personnel to step up production and produce more reliable results.

The author is Chief, Hydrology Branch, Soil Conservation Service, Washington, D. C.

Revised Programs Show Expanding Role of Districts in Conservation

By John W. Barnard

MODERNIZED soil conservation district programs tell an exciting story of advancing technology and expanding concern for resource development and conservation in the 1960's.

Across the Nation more than 1,200 district governing bodies have responded to Secretary Orville L. Freeman's invitation in 1962 to update their working relations with the Department. They have revised their programs and signed new basic memorandums of understanding with the Department. The Soil Conservation Service in turn has revised its supplemental memorandum of understanding with each accordingly.

The new programs present an interesting story of progress, of thought and study, and of hard work. They show an increasing understanding of multiple use of land and water. They involve a widened range of assistance from local, State, and Federal agencies and private interests to carry forward conservation work according to local needs.

More and more conservation districts are finding that concepts of soil and water conservation have changed since they were organized. Increasing population with resulting shifts in demand for land—for agriculture, urban, recreation, and other uses—calls for adjustments in use and creates new needs for treatment.

Land and water problems are still among America's most important concerns. The new conservation district programs chart the course of action to solve these problems.

The conservation district movement is a distinctly American effort—possible only under our democratic way of life and the free institutions which can flourish under this system.

Programs developed 20 to 25 years ago, when districts were first organized, do not fully meet the needs of modern conservation. It is not enough, today, to stop erosion and control runoff. Modern conservation districts must recognize all phases of resource conservation — soil, water, vegetation, wildlife, and related resources. The reduction of floods and sedimentation damage and development of outdoor recreation are important segments of total conservation. And the place of conservation in rural areas development to provide additional employment opportunities is a prime consideration in many districts.

A review of a few of the new programs from different parts of the country reveals the expanding role of districts in the conservation, development, and use of our land, water, plant, wildlife, and outdoor recreation resources.

Jackson County District, Ark.

The Jackson County Soil and Water Conservation District supervisors revised and printed an attractive program in 1963. The original program was developed in 1945, and revised in 1950.

This county of 407,680 acres was originally a "soil conservation district," but now is a "soil and water conservation district." The 1945 census of agriculture showed 2,738 farms with an area of 287,927 acres; the 1960 census showed 1,235 farms with 349,000 acres. Between these dates, the average size of farm increased from 105 to 283 acres. Cotton and rice are the main types of farming. Population of the district in 1940 was 26,427; by 1960 it had declined to 22,843.

Experience of the supervisors and conservation needs information provided a basis for updating the program. The broad objectives of the original program still are applicable, but the need for income-producing recreation developments, treatment of land not in agricultural use, and group action to solve watersheds problems are important additions.

Middlesex District, Mass.

The Middlesex Soil Conservation District in northeastern Massachusetts was organized in 1947. Its total area is 530,560 acres. At that time it had a population of about 1 million and a diversified agriculture with 210,237 acres in farms. These farms sold over $22 million of products or one-fifth of the State total.

The primary objectives of the district as stated in the original program were to improve farm drainage and reorganize crop fields so as "to adapt them to the use of modern machinery." Except for isolated areas, erosion was considered a minor problem. Other needs included proper use of woodland and establishment of wildlife refuges.

Fifteen years later the population of the district had increased by a quarter of a million. The cropland acreage had dropped from 87,000 to 41,000 acres; it is expected to be down to 34,000 acres by 1975. There is still an intensive agriculture in the district but the supervisors recognize the need for a changing program

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to meet the changing conditions.

In 1963 the district had more than 1,000 cooperators and the needs for assistance were growing—but in new directions. The pressures from the Boston metropolitan area were putting more land into nonagricultural uses. Both public and private interests were increasing their holdings for income-producing recreation, speculative purposes, nonprofit recreation, club grounds, and institutional construction.

The enactment of a Town Conservation Commission Law and a broadened "Conservation District" Law have brought about decided changes in district programs and activities. In addition to the needs outlined in the original program, the new program includes flood-prevention and multiple-use structures in watersheds, resource inventories, and broad land use planning.

Stevens County District, Minn.

The Stevens County District was organized in early 1956. Its area is 364,800 acres, of which 95 percent was in farms, mostly used for growing cultivated crops.

The original district program outlined the needs as soil and water management, erosion control, pasture improvement, woodland and wildlife improvement, and control of floods. It states the need for education to get farmers to recognize the value of conservation. Technical assistance and cost-sharing to aid cooperators in carrying out conservation plans on individual farms are stated to be district policy.

The supervisors revised their district program in 1963. They state, "We present this new program to serve as a new foundation upon which to build a better district and community." The primary purpose of the district was to continue to be "to provide leadership, education, and technical assistance to farm people in conserving soil and water through combinations of good land use practices."

In addition, their revised program includes such purposes as to (1) endeavor to make available financial aid where needed for the conservation and development of a resource; (2) initiate the small watershed program where this will help solve soil and water problems; (3) protect and expand outdoor recreation and wildlife resources; (4) provide cooperative action with all agencies and groups to realize full potential of natural resources to aid in the economic growth of the community; and (5) continue community planning.

This splendid program is backed with documentation of problem needs and solutions. Actions and district policies to accomplish the job are well stated.

Northumberland County District, Pa.

The Northumberland County Soil and Water Conservation District directors revised their program in 1963. They have released an impressive printed document that describes the natural resource problems and the needs for conservation.

The district was organized in 1943 covering only part of the county and expanded in 1949 to include all of it. From reading the program one can tell that the directors are proud of their district and want to make it a better and more attractive place for outsiders as well as for local residents. The district isn't large—only 290,560 acres. Eight hundred landowners are cooperators.

When the district was organized about 20 years ago, the principal assisting agency was the Soil Conservation Service. The revised program lists 25 local, State, and Federal agencies and private institutions and groups working as a team to get the conservation job done.

The distinctive feature of this district program is the comprehensive inventory of the agricultural, woodland, and urban uses of land, and projections of urban use to the year 2,000. Recreation and water uses are inventoried by watersheds, and potential sites for improvement and development are indicated on maps.

Part of this district is in the depressed anthracite coal area. Population in 1940 was 127,000 and in 1960 was 104,000. The directors believe that resource development, especially of water resources, will attract industry, increase tourism, and halt the declining trend in population.

Johnson County District, Nebr.

The Johnson County Soil Conservation District in southeastern Nebraska was organized in December 1942 with an area of 232,500 acres. Its program in 1943 listed six State and Federal agencies as giving assistance.

In order to meet production demands of World War II, corn and soybean acreages were increased with resulting acceleration of erosion. The supervisors believed that a large acreage then in cultivation could contribute more to the war effort if it were used for alfalfa and bromegrass pasture and hay. This would enable operators to handle their land more efficiently with the decreased supply of farm labor.

District objectives included retirement of steep eroded cropland to grass and trees, improvement of crop rotations, maintenance of crop residues, gully control, establishment of complete water-disposal systems, pasture management, and establishing windbreaks and wildlife areas.

The revised program developed in 1963 mentions 16 agencies and groups as providing help to the "soil and water conservation district." After 20 years 1,200 of a total of 1,500 land owners and operators were cooperating. About one-half of these had basic plans,

(Continued on p. 278)

Rice Irrigation Reservoirs Help Meet New Water Needs and Aid Economy

By William B. Davey

COOPERATORS of the Arkansas County Soil Conservation District in Arkansas now have water in greater quantity, with better quality, and at less cost than they ever had before.

The challenge of an increasing need for water and a steadily lowering water table is being successfully met by a new type of irrigation system that impounds surface water in reservoirs and circulates it for reuse until absorbed or evaporated. The Soil Conservation Service devised the system to meet the peculiar conditions of this rice-farming area.

Arkansas County farmers use a great deal of water for their rice and soybean crops. It takes about 1 acre-foot of water to grow an acre of soybeans and 3 acre-feet to grow an acre of rice. With more than 70,000 acres of rice and nearly 250,000 acres of soybeans planted annually, it doesn't take a slide rule to show that farmers need nearly half a million acre-feet or 150 billion gallons of water annually for those two crops alone.

This big demand developed in the early 1950's when a growing market for soybeans resulted in a big increase in acreage and heavy use of fertilizers to increase yields. Before then, soybeans had been grown mainly to keep down weeds in ricefields; the yield was of secondary importance. The soybean, like rice, is a "thirsty" crop, and the heavy fertilization called for still more water.

Before 1950 most of the water for irrigation in Arkansas County was pumped from deep wells. In 1925 the U. S. Geological Survey found the water table dropping about 6 inches a year and recommended that rice growers substitute surface water for ground water. The advice was disregarded. Then two things happened.

First the wells started pumping alkali water with a high pH. This caused lower yields, since rice does best in acid soil. With rice bringing $2 a bushel, this put the squeeze on farmers where it hurt the most—their pocketbooks.

Next, farmers began using more water when they started growing soybeans commercially. The answer to the problem of adequate water came when the technical know-how of the SCS was put to work with financial help of the Agricultural Conservation Program to construct new irrigation systems including reservoirs to hold water for use and reuse.

Some of the water for the reservoirs comes from surface runoff, but opportunity for trapping water by gravity is limited in the flat delta area of Arkansas. Most of the water is pumped from nearby bayous. It first goes into a storage reservoir, then into a canal from which it is released onto the cropland.

The water that isn't used by the crops or that doesn't evaporate is

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recovered from the lower end of the field and returned to the reservoir for reuse. In this way, the farmer gets maximum benefit from the available water supply. Farmers say that "they run the water over their fields until they wear the wet out of it."

District cooperators have built some 330 reservoirs in the past 10 years. To do this, they moved an estimated 10 million cubic yards of earth. The water being stored in these reservoirs for crop production runs into the billions of gallons. The ACP share of the construction costs has amounted to about $420,000, and the landowners have spent about $4 million. Construction cost ranges from $189 an acre for reservoirs less than 25 acres in size to $93 an acre for those larger than 100 acres.

Construction of these reservoirs has not only provided Arkansas County farmers with plenty of good water for rice and soybeans, it has also brought many side benefits.

Farmland in the county that previously would not have sold for $50 an acre now brings as much as $400 an acre. An estimated $3,200,000 is spent annually to install field ditches and underground irrigation pipes and for the purchase of pumps and other equipment. The sale, operation, and upkeep of irrigation equipment runs into many thousands of dollars annually. And soybean production has attracted a $2½ million soybean processing plant to the town of Stuttgart, which employs 50 people. In addition to attracting ducks, nearly all the bayou-filled reservoirs contain bass, bluegill, and crappie.

All of this has meant increased business and better times in Arkansas County. And it has shown the value of ingenuity and teamwork in solving a water problem.

With proper irrigation, soybeans yield about 40 bushels per acre; without water, about 20.

Rice harvest brings the payoff for reservoir construction.

Reservoir No. 1 in foreground is filled by gravity flow. From there, water is pumped through underground pipeline to Reservoir No. 2, from which it is released for irrigation.

Revised Programs

(Continued from p. 275)

and substantial progress had been made in getting conservation on the land.

Important new additions to the district program are small watershed projects and rural areas development. Considerable emphasis is placed on wildlife and recreation lands. These include numerous ponds and impoundments from the larger watershed structures. Camping and cabin sites are considered as an important potential land use. Promotion of the area for quail hunting is mentioned as an additional source of local revenue. Adjustment in farm size to encourage livestock farming is still an important need.

Thurston County District, Wash.

The Thurston County District in western Washington has an area of 460,000 acres. At the time of organization in 1948 there were 2,848 farms, averaging 54 acres each. More than half the farm operators received off-farm income. While the average rainfall is 40 to 80 inches annually, lack of summer moisture seriously limits crop and pasture yields.

The original district program mentioned 24 land use problems and the corrective action to be taken. Included were such things as crop rotation, drainage, proper grazing, proper use of irrigation water, economic size of unit and type of enterprise, control of streambank erosion and flooding, tree planting and forest management, fish ponds, and restocking of lakes. Other problems related to soil fertility, weed control, and rodent and predatory animal control.

The program developed in 1962 stated that much had been accomplished but the three primary land use and management problems remained: Proper utilization of the droughty infertile prairie soils, proper utilization of wet, idle cutover land, and woodland management. The number of farm irrigation systems had increased steadily, and forage crops were grown on 90 percent of the cropland. A rapid change in land ownership was taking place, resulting in a 40-percent turnover in district cooperators. Only 526 farms had sales of $2,500 or more per year.

Important in the new program are attention to recreation and urban and built-up areas. In the district are 108 lakes totaling 5,500 surface acres, numerous State parks, and many private campgrounds. The district intends to make cooperators aware of possibilities for income-producing recreation on their land and to cooperate with all agencies in controlling pollution and maintaining recreational developments. The supervisors were cooperating with the county planning committee and the Rural Areas Development Committee in developing county resource plans.

Taos District, N. Mex.

Agriculture in Taos County is many centuries old. The Indians used irrigation for hundreds of years to raise corn, squash, and beans. Spanish stockmen settled in the county in the early 1600's. The range was open, and as a result of uncontrolled grazing one of the most serious problems today is the badly denuded rangeland. The Spanish system of inheritance, in which all children share equally, has divided and redivided farms so that 40 percent of the holdings today are less than 10 acres in size.

The Taos Soil and Water Conservation District was organized in 1941. Forty percent of its area of 1,443,000 acres is privately owned. Except for 62,000 acres of Indian holdings, the remainder is national forest, public domain, or State land. Since almost all of the cropland is irrigated, the original program gave high priority to the needs of this land. Range seeding and management, stock-watering facilities, and related improvements also received much attention. Erosion control, soil improvement, fish ponds and lakes, and development of outdoor recreation facilities were emphasized.

In a well-documented program printed in March 1964 entitled "Assuring Our Future Through Conservation," the board of supervisors charted the needs for action in the future. This district is in the Northern Rio Grande Resource Conservation and Development Project to accelerate conservation and development of resources for the economic betterment of the area. Substantial amounts of additional irrigation water are expected to be available through a diversion project. The recently completed Conservation Needs Inventory provides quantitative information about current problems.

The supervisors state, "Originally our primary interest was erosion control and soil conservation. We are now concerned with the full range of development, use, and conservation of soil and water resources, recreation, urbanization, and other resources." Specifically the objectives are to (1) increase small watershed activities for flood prevention, watershed protection, and multiple use; (2) complement the district program with rural areas development; (3) gear the program to meet needs for outdoor recreation including farm resources; (4) encourage economically sound family-type farms; and (5) promote research to aid in the orderly resource development and conservation.

Soil Sterilants

Before you use soil sterilants for weed control, know where the roots of nearby desirable plants, including trees and shrubs grow, and know where runoff water could take the sterliant; once in the soil, the chemicals can kill plant growth for several years.

A Question for Landowners—

Is Your Dam a Bargain?

By H. L. Cappleman

WHETHER shopping for furniture or building a dam, we all like to think we're getting a bargain.

But in seeking bargains we must be careful to compare quality as well as cost if we are to avoid becoming like Oscar Wilde's cynic, who "knows the price of everything, and the value of nothing!"

For most of us, bargains in earth dams are harder to recognize than bargains in groceries or hard goods. And the consequences of risking our money on a doubtful bargain in dams may be far more serious than with groceries.

Picture the plight of the owner of the "bargain" car with faulty brakes numbly staring at the junk that was his car lying in a mass of rubble that was lately the smart facade of an expensive building. Over the drumming thought that "It's all my fault," the despair of the luckless car owner may be momentarily lightened by the thankful prayer that no one was seriously injured.

Equally chilling is the lot of the owner of the "bargain" dam, standing by the ragged scar that was once the embankment, gazing over the eroded subsoil that was once his best field, past the tumbled mass of debris that was once the county bridge, at the silty mess covering what was once his neighbor's strawberry crop. Like the car owner, his gloom too may be pierced with relief at the lack of casualties. But here the similarity of their fortunes ceases.

On regaining his reasonable senses, the car owner may look forward to the recovery of his investment in the car and the payment of the damages through the medium of his collision and liability insurance. True, he stands to pay his price in inconvenience, harassment, embarrassment, and regret, but his financial liabilities may be matters of mere technical concern.

Not so, the dam owner! Even assuming that he could and did afford liability insurance that covers such events, what portion of the damage does it cover? Will it return to him his original investment in the dam? Or pay the cost of replacing the dam? Will it mollify the motorists who must detour pending replacement of the bridge? Will it convince his neighbor that he was justly compensated for the crop he couldn't harvest? Will it replace his own ruined field? Or recondition his neighbor's? The gloom deepens.

Such things happen sometimes. And when they do it is often because of the innocent belief of uninformed people that a dam is just a pile of dirt and "any old dirt will do." This philosophy often spawns the "bargain" dam—conceived without benefit of design and built without benefit of supervision on a site unspoiled by investigation. At worst, "bargains" like that can lead to tragedy; at best, to excessive maintenance cost and worry.

Horror stories notwithstanding, dams serve many beneficial purposes. Under certain conditions they are vital to the economy and contribute to the health and well being of individuals and communities. In the proper circumstances they can be built and used with every reasonable assurance of safety and proper functioning throughout their economic lives.

Such reasonable assurance is based on adequate planning, sound design, and competent construction; it requires the services of professional engineers and geologists to perform surveys and investigations, develop plans and specifications, and inspect construction. The cost of such services varies with the scope of services required to do the job. What constitutes a reasonable cost of engineering services varies with the complexity of site conditions and the hazards (failure consequences) involved.

Whenever water is impounded in considerable quantity and at considerable depth or height above the flood plain a hazard is created. The extent and nature of the hazard will depend on the location of the damsite in relation to things or people that might be damaged or injured as a result of failure of the dam.

The hazard of any given site may vary from simply the risk of loss of the owner's investment to the risk of catastrophic loss of life and damage to property. The higher the hazard, the higher the owner's risk and the greater the need for extensive investigation, conservative design, and good construction inspection.

Dam building is usually motivated by economic considerations; the benefits to be derived from the dam are expected to exceed the cost of building it. However, the builder also has a moral responsibility to consider the possible effects of the dam on the community and to do his best to minimize the danger to the community.

The designing of earth dams is by no means an exact science. It consists of about two parts science

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and one part art, seasoned with intuition and molded by judgment. It requires the application of the principles of hydrology, geology, hydraulics, mechanics, economics, and common sense by experienced geologists and engineers. Even when accomplished by trained and experienced people, it is no sure guarantee that failure will not occur under some combination of circumstances. Therefore, the decision to build a dam must be based not only on the relationship of benefits to costs but also on the relationship of benefits to risk incurred by the creation of the hazard.

For dams above a certain size, many States have legalized the owner's responsibilities to the community. The requirements for obtaining State permits and licenses for dams vary considerably. Usually they provide for reviews of designs and inspection during construction of all dams more than a certain height or impounding more than a certain volume of water, or both.

These reviews and inspections (for which the owner pays certain fees) do not relieve the owner of the responsibility for the design of the dam or the inspection of construction, nor do they relieve him of any liability for the consequences of failure. Their purpose is to insure that reasonable precautions have been taken to insure the safety of the community.

Whatever the law may provide, the requirements for State permits are usually based on arbitrarily chosen sizes of dams and reservoirs. Size is not a good criterion of hazard. Many cases of serious damage caused by failures of small dams are on record. I know of one instance in which the failure of a dam only 10 feet high and impounding only 5 acre-feet of water caused damages in six figures.

The location of the dam is the key to hazard. And hazard is the key to the owner's risk, regardless of the size of the dam. Reliance on State permit requirements to indicate the need for engineering services is a misinterpretation of the intent of the regulations and amounts to foolhardiness on the part of the owner.

Soil Conservation Service policies and standards are intended to insure that Federal funds are not applied to the creation of community hazards or ineffective practices.

The retaining of good engineering services does not assure the owner of a dam in the site he desires. Sometimes the best service the geologist and engineer can do for the owner is to recommend that a dam *not* be built.

Generally, the economic feasibility of an earth dam depends on the use of materials obtained from borrow areas at or near the damsite. The suitability of soils for use in earth dam construction varies with the characteristics of the soils, the topography of the site, and the character and condition of the foundation.

Proper design and construction methods will allow the use of most soil materials for this purpose, but, for any given site, the cost of the dam will likely increase as the quality of materials decreases. The examination of a site should include an assessment of the soil erosion potential and an estimate of sediment production from the watershed. Effective land treatment commonly needs to be planned to accompany (or, better, precede) dam construction. In some cases the combination of conditions found at a site or the prospect of sedimentation from the watershed above may render the undertaking so hazardous or so unlikely to function as to make the owner's investment a very poor risk.

The cost of such so-called "negative reports" is not wasted if they save the owner a large investment in a worthless site. The wise owner will heed such recommendations and either verify them by further studies or abandon the project.

When you decide that the benefits to be derived from a dam outweigh the cost and hazard of owning one, then it is good business to protect your investment and reduce your risk by the use of the best methods and talent available. These methods and talents may not be cheap, but, when measured against the consequences of failure, they are true bargains in the long run.

Have You Seen?...

• "Know Your Soil," by Soil Conservation Service, USDA's Agriculture Information Bulletin 267. Soil information is useful to all people—farmers, ranchers, and foresters, and city people ranging from homeowners to land appraisers, realtors and builders, to city planners, manufacturers, and insurance companies. This bulletin tells why a soil survey is necessary, how it is made, and why a soil survey report (published after the soil survey is finished) should be consulted.

• "Russian-olive for Wildlife and other Conservation Uses," by A. E. Borell, Soil Conservation Service, USDA Leaflet 517, superseding Leaflet 292. No other tree surpasses Russian-olive for wildlife food and cover in the Western and Plains States. This leaflet tells what Russian-olive is, where and how it grows, and where and how to plant it; describes its care and management; and lists birds and mammals known to eat Russian-olive fruit.

◆

It's the green blades of grass that manufacture food for the plant. If you mow off 90 percent of the blade, root growth stops for several days to as much as more than a week.

Watershed Research Seeks Ways to Improve Planning

By L. L. Kelly

WATERSHED research has been carried out by the U. S. Department of Agriculture in cooperation with State Experiment Stations since the early 1930's. In the Department, the responsibility for research in this field for farmlands now rests with the Agricultural Research Service and for forested lands with the Forest Service. The Economic Research Service and the economics departments of the State Agricultural Experiment Stations provide basic economic data to express the physical facts in terms of dollars and cents.

Additional research information from these experiment stations and universities and much information from the U. S. Weather Bureau, U. S. Geological Survey, and other agencies are adaptable to the needs of planning and designing programs for watershed protection. The Soil Conservation Service uses many of the research findings in the watershed protection program.

To plan and design an efficient and effective program for watershed protection and development requires estimates of many features of streamflow and sedimentation. Among them are: (1) How large the floods are now and how often they come, and what effect the planned program will have on the size and occurrence of floods in the future; (2) how much sediment is carried out of the watershed now and how much will be carried in the future with the program in operation; (3) how changes in streamflow and sediment loads will affect stability of stream channel systems; and (4) what the dependable water yield of the watershed is now and what it will be in the future with the program installed.

The improved design for a spillway becomes a reality when the dam is built in the field.

A transparent laboratory model of a spillway is used for study in the St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minn.

If these and similar estimates can be made with a high degree of accuracy, costs of the program can be kept to a minimum; if not the planner must increase the "factor of safety" at greater cost of construction. One of the aims of research is to provide the tools for making these estimates as accurate as possible.

But making estimates of the flood flows likely to occur on a particular watershed is a complicated task. It is obviously too expensive to measure the flood flows from the thousands of watersheds that are in need of protection programs. The flows must be estimated from a knowledge of the relations between rainfall, soil, vegetation, and the many other factors influencing flood runoff.

We all know that floods are caused by rain; but sometimes big rains cause big floods and sometimes they don't, and sometimes

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No. 76

This is the seventy-sixth of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

little rains cause big floods. There is a relationship between rainfall and runoff, but it is a complex one, affected by the amount and intensity of the rain, the amount of moisture already in the soil, the type of soil and geology, the vegetation—as many as 30 different factors altogether.

The Agricultural Research Service and the Forest Service are providing information on this relationship. Studies are being carried out on between 400 and 500 research watersheds to sample the combinations of soil, vegetation, and farming practices on the land where floods start. Additional research watersheds are needed in major soil areas where this kind of information is not being obtained.

Equally important are the estimates of sediment likely to be produced by a watershed. Here, the planner starts with the conservation axiom that "sediment in streams is the product of erosion on the land," and he must express this relationship with numbers. This is not a simple relationship, for many factors of climate and soil influence erosion. Also, all the eroded material from a hill slope is not necessarily carried downstream to the first reservoir; some is deposited at the foot of the slope, some on the flood plain. The streambanks, too, contribute sediment.

The planner relies on aids like erosion prediction equations, information on gullying and streambank erosion processes, systems for computing sediment transport and delivery, and knowledge of the trap-efficiency of reservoirs to estimate the sediment likely to be deposited in a reservoir.

Engineering structures are another important feature of the watershed protection program. Research is carried out continually to improve the efficiency of the various parts of such structures so the program can be installed with least cost. Much of this research is done in laboratories with small scale models of the real thing. For example, air is used instead of water in many cases to determine efficiency of the spillway entrance. The hundreds of laboratory tests required to arrive at this efficiency under various conditions can be run much faster with air than with water and the results made available much sooner.

The closed-conduit spillway with drop inlet, another example, has been used for many years, but continual improvements are being made. Various trash racks also have been tested in the laboratory in determining the best one.

Although the purpose of research is to predict what will happen under a given set of conditions, sometimes, because the hydrology and sedimentation processes in watersheds are so complex, the researcher can take only "samples" of the thing he is studying and, from an analysis of the samples, state some rules and provide average figures for use as the tools for making estimates. But what he seeks most is the natural laws that govern the processes themselves to provide the best tools for making accurate estimates and for the most economical and efficient planning and installing of watershed programs.

Moon Stones

Residents of six counties of western Iowa have been asked to look for stones while plowing and report unusual finds to their local soil conservation or county agent offices.

In this way, the National Aeronautics and Space Administration hopes to find fragments from the moon or outer space for study.

The western Iowa area was chosen because the thick blanket of windblown material that underlies the loess soil is remarkably free of native stones.

Doubled Benefits By Shift to Grass

A double benefit to his farming operation was planned when R. J. Dinwoodie, of the Fort Berthold Soil Conservation District, N. Dak., replaced his cropland with grass.

Cropland was converted to grass to better stabilize the economy of the 2,000-acre unit under the Great Plains Conservation Program. This permitted him to add to his cow herd and decreased the cost of operation of small pieces of land away from farm headquarters.

Dinwoodie seeded 120 acres of cropland to native grass for grazing and 44 acres of cropland to tame grass for hay. He also added stock-water dugouts, wind stripcropping, and grassed waterways.

Wildlife Food

A three-way cooperative agreement for testing wildlife food plants has been developed between the California Department of Fish and Game, California Division of Soil Conservation, and the Soil Conservation Service.

A similar agreement covering cooperative work on waterfowl food plants has been in existence for some time. This has worked out so satisfactorily that the two State agencies requested it be expanded to cover food and cover plants for upland game.

Testing will be done by direction of the Pleasanton Plant Materials Center.

Conservation Saves Farmers' Water In Southern Utah Drought Counties

By Clyde W. Larsen

CONCRETE ditch lining is one of the conservation measures farmers in drought-striken southern Utah counties have used with profit to bring short supplies of irrigation water to their hay and other crops instead of letting it get away through earth canals and ditches.

They recognized 15 years ago the advantages of installing irrigation water-management practices on their farms and are speeding up the installation of this and other water-saving practices like land leveling.

Irrigation companies in the Delta Soil Conservation District, for example, commenced to line their main canals with concrete in 1960. In the past 3 years they have installed 10 miles of concrete canal lining and ¼ mile of plastic liner. This year, 1½ miles of plastic liner will be installed in a flat canal that has a higher water loss. Most of the canals and irrigation ditches also have been lined with concrete in the St. George area, where a visitor would have to search to find water running in old earthen ditches.

In the Delta district, farmers have leveled 38,000 acres to the proper grade. This is about 75 percent of the irrigated land in the district. Many old timers like Roland Crane of Salina, Max Tuft of Monroe, and V. C. Carling of Fillmore have leveled most of their irrigated land to a grade designed by the Soil Conservation Service.

In recent drought years, water users have made these and other water-management practices pay off. By carefully measuring out water to their crops, farmers in southern Utah produced some of the largest first-crop cuttings of hay on record in 1961 and 1963, in spite of one of the worst droughts on record. They were followed by near-normal second-crop cuttings and average grain yields on those farms that had enough water for one application on the second cutting of alfalfa hay and one to two irrigations for the small grain. Edson Alvey, a school teacher and farmer, in the Escalante Soil Conservation District, for example, has been averaging 7 tons of alfalfa hay with three cuttings, since he has leveled his fields and began managing his irrigation water applications and maintaining proper soil fertility.

"Concrete ditch lining has answered my irrigation water-control problem," says Vernon Johnson of Aurora in the San Rafael Soil Conservation District. "By remodeling my irrigation system and lining my ditches with concrete, I now can control the irrigation water and regulate it without waste almost as fast as I can walk down the ditch. The water gets there now as fast as I can regulate it."

The Loss Creek Irrigation Company near Circleville in the Piute County Soil Conservation District completed 3¼ miles of concrete canal lining in the spring of 1961. Rex Whittaker, a lifelong resident, whose Lizard Ranch is at the lower end of the canal, reports on his water-saving experiences:

"The drought of 1959, 1960, 1961, and 1963 has been especially hard on irrigation farmers who are depending on the natural streamflow for a water supply. In 1960, the old earth canal lost all our water, and I couldn't irrigate a thing. In 1961, with the same amount of water diverted into the head of our new concrete canal, I have been able to irrigate about 50 acres of potatoes. The drought of 1963 lowered the creek near or to an all-time low, until I was receiving only 20 percent of my primary water. But, thanks to the concrete canal, I was still able to mature 40 acres of oats."

This concrete irrigation ditch lining in the Delta Canal System is serving its third season of water saving.

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Farmers, cooperating with their soil conservation districts, are learning more about the amount of water and time to irrigate that different crops require. Take Gale Whittaker in Piute County:

He will tell you that "conservation practices that save water make better crops and neighbors." He constantly checks the soil moisture in his potato fields and applies only the amount of water needed to replace the moisture used and keep the vines thriving.

The sprinkler method has been selected by many farmers in Wayne County among the several methods that can be used to obtain good, sound water management. Twenty-five sprinkler systems, covering 3,000 acres, were installed in 1961-62 and 1963. To encourage them to irrigate according to the moisture in the soil, the Fremont River Soil Conservation District makes moisture probes available to cooperators at cost. SCS technicians demonstrate their use.

Grading and shipping minnows are part of Frank McCortney's regular conservation farming operation.

Minnow Farming Expands As Land Use in Arkansas

By Roy A. Grizzell, Jr.

IF you should go bass fishing with minnows in Florida, Texas, or in many other States, 9 chances out of 10 your minnows were raised in Arkansas.

Early in 1962 we conducted a survey of minnow farms in the Land-Of-Opportunity State. This survey showed 141 landowners engaged in minnow farming, utilizing about 8,000 acres of land. Of this number, 72 farmers were operating enterprises of less than 15 acres and were considered part-time operators.

Minnows are sealed in plastic bag with water and air for shipping.

In 1964 the up-dated survey showed the number of operators had increased from 141 to 157 and the amount of land from 8,000 to 9,200 acres.

The demand for minnows will continue to increase. In fact, the U. S. Census Bureau figures indicate that each morning there are 7,000 more people to be fed, clothed, and housed. About 1 in 4 of the men and 1 in 10 of the women will become fishermen and fisherwomen. Operators who produce their fish most efficiently will continue to expand, following the trend in other types of agriculture.

The Anderson Brothers, cooperators with the Lonoke County Soil and Water Conservation District, claim to be the largest minnow farmers in the world. They devote more than 800 acres of their farm to minnow production and also act as wholesale agents for numerous other farmers, such as H. H. Harvill and Son, cooperators with the Arkansas County Soil and Water Conservation District.

To farmers engaged in minnow enterprises, the Soil Conservation Service for many years has been giving technical assistance through the districts on pond design and construction, stocking of brood minnows, management of ponds to produce optimum growing conditions for young minnows, harvesting operations, and control of trash fish, diseases and parasites, predaceous water insects, crayfish, and aquatic weeds. In fact, the opportunities have proved sufficiently lucrative to lure two former Soil Conservation Service biologists into the business.

Most minnow farmers in Arkansas produce the golden shiner minnow. Some specialize in goldfish and fatheads. A few grow Israeli carp or the common carp for trotline bait.

Minnow farming, like other types of modern agriculture, requires a scientific approach. Oper-

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ator Malcolm Johnson of the Delta Farm Fisheries and a cooperator with the Drew County Soil and Water Conservation District explained to a group of foreign nationals recently that he had to run his business with the same care as a hospital. He uses antiseptics in all steps of his operation to prevent disease and parasite epidemics. Each morning at daylight during the warm months every pond must be checked for oxygen shortage in the water.

Many of the larger minnow farmers have developed rotation systems alternating cultivated crops with fish. Crops commonly grown following fish are rice and soybeans.

After several years of continuous rice, yields on even the best Delta land begin to decline. One of the principal factors in reduced yields is increased weed competition. Many noxious weeds and weed seed are rotted when rice is followed by minnows or other fish. Organic materials are decomposed and return as basic plant-food material to the soil. Yields have been remarkable when the land is planted to field crops again. Rice commonly yields 100 or more bushels an acre and soybeans 30 bushels an acre or better after fish.

Minnows on well-managed farms maintain profit margins equal to or often superior to other farm products. New techniques are constantly being developed and applied. This is one nonsurplus farm product that is experiencing an increasing demand.

Large Watershed Dam to Provide Recreation Area

By John M. Cross

ONE of the largest reservoirs under the Watershed Protection and Flood Prevention Act (Public Law 566, as amended)—the Cotile Reservoir, a major feature of the Bayou Rapides watershed near Alexandria — is being built in Louisiana.

It also is one of the first reservoirs to be approved for Federal cost-sharing for recreational benefits when a supplemental work plan agreement was pushed through soon after the change in the law which allowed cost-sharing for recreation.

The specifications for the Bayou Rapides project call for a dam containing 885,000 cubic yards of earth; a lake covering 1,775 surface acres, a thousand or more of which will be maintained for recreation; and 18,573 acre-feet of water available for irrigating some 10,000 acres of good Red River valley land below the dam. Bayou Rapides will be converted into a delivery system, taking the water to users, and will provide 20 miles of fresh water fishing.

Sponsors of the project are the Rapides Parish Police Jury (governing body) and the Lower West Red River Soil Conservation District. The Soil Conservation Service provided engineering and design assistance.

The cost of the project is estimated at $4,664,600 including expenditures for land treatment and an irrigation distribution system that will cost $233,000. An $1,500,000 estimate on the construction of the dam will be divided equally between local and Federal funds. Economists say the project will pay $2.60 in benefits for every dollar spent. Dollar value of the recreational benefits alone is estimated at $111,735 each year.

The 1960 census shows 263,992 people living within a 50-mile radius of the proposed site—possible users of the recreation facilities. Based on studies made in similar sites the sponsors predict that 48,750 visits a year will be made to the reservoir.

On their 2 tracts of land totaling 100 acres adjacent to the recreational pool, the Police Jury have agreed to build a minimum of 60 picnic units and 30 camping units. They plan to provide 800 feet of beach area and will build dressing rooms, showers, and sanitary facilities next to the area. Boat ramps and docks will be built, too. Two shelters will be provided, and 4 miles of access roads will be built.

Local people have a keen interest in the Bayou Rapides project. They voted a $2¼ million tax on themselves to raise their share of the funds to help pay for this project and other watershed developments. The Police Jury purchased all the land needed for the project. There are many secondary benefits that can't be expressed in dollars and cents. Better land use, tourist trade, efficiency in farming operations, vitalization of local business, and development of rural areas are some of those benefits.

Tank on pickup bed for moving goldfish from ricefield to holding ponds.

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'Step Dam' Builds Self and Stops Gully with Sediment

By Bill Phillips

A UNIQUE "step dam" has met expectations of its creators since construction started 10 years ago in Riverside County, California.

Conceived by Vern W. Hale of the Soil Conservation Service and Rancher Louis Haskell, the first of five steps was poured in 1953 in an erosion gully gashing cancerously across a fertile portion of the Haskell Ranch. The gully was the result of runoff water from a 3,000-acre watershed seeking quicker access to San Timoteo Creek.

Haskell and his brother, Kelsey, own 3,200 acres of what was once the pioneer Singleton Ranch in San Timoteo Canyon. They started worrying about the continual widening of the erosion channel; and Louis Haskell conferred with Hale, who agreed that erection of a concrete dam would pose a tremendous problem. Estimations showed expense of such a dam would run $15,000 to do any good in the gully, which was 30 feet deep and 70 feet wide.

"And," Hale recalls, "there was no guarantee a storm would not wash out a single wall dam."

So Haskell and Hale came up with an idea: Why not a series of check dams, one behind the other, constructed over a period of years, with natural sediment allowed to fill behind each 3-foot wall? As Hale noted: "The dam is supposed to stop erosion, which is what it's doing; but it takes erosion upstream to help build the dam."

The first wall, of concrete, was poured with the sides sunk 2 to 3 feet back into the banks of the gully, and rising 3 feet higher than a level 12 feet in the middle, to train the future flow of floodwaters into the center of the channel. Floodwaters through the gully filled the upper side of the wall with debris. Then a second 3-foot wall of concrete was erected, 6 feet upstream from the first, and the fill between was covered with a concrete floor so flowing waters would not dig.

"It didn't get a good test until 2 or 3 years ago," Hale reported. "The top lift wasn't in. There was a cloudburst above Calimesa. Two inches of water fell in 10 minutes in an early fall flash flood. That's equal to a 50-year expectancy estimate. But all it did to the step dam was just clean out behind it and level out an area for a half mile that was 5 feet deep behind the top step."

Over the 10-year period, growth of the dam has been at a step every other year. One year, giving Nature a little help at the compaction, they got two in, and then went 4 years without anything.

Visit the location in the golden waving barley field where the steps are located, about 200 feet from the channel of San Timoteo Creek near the railroad tracks, and you can see that, over the 10-year period, depth of the eroded channel has been reduced approximately 17 feet. Hale figures that two more lifts will turn the channel behind the dam location into a gentle swale where grain will grow again. Then, by putting in small check dams up the gully every several hundred feet, soil conservation techniques in a long-term program will turn the length of the channel into swaled, grassed land, eliminating the gully.

Technical aspects of the step dam include a 2 to 1 slope, weepholes to keep down pressures on the steps, concrete used without steel, and footing 2 feet deep for

Step dam is built in stages as sediment fills in behind each new concrete wall.

The author is managing editor, *Beaumont Daily Gazette*, Beaumont, Calif.

the 1-foot thick steps.

"What we have here after 10 years," Hale explains, "is the equivalent of a 15-foot dam." However, it's a debris dam, not a storage dam; and, unlike a single-wall, reinforced concrete dam, its chance of failure is much less—yet it has been built at approximately 10 percent of the cost of your usual upright dam."

Haskell, president of the San Gorgonio Soil Conservation District, estimates the cost at $300 per 3 feet of height lift, or $1,500 for the five steps now constructed.

TREES AGAINST THE WIND

By David W. Despain

TREE windbreaks throughout Wyoming's Cody Soil and Water Conservation District are adding protection to land and property from damage caused by up to 75-mile-an-hour winds that sweep down the North Fork valley of the Shoshone River from Yellowstone Park to Cody.

One incentive to ranchers to plant windbreaks as part of their conservation programs planned with Soil Conservation Service help has been the successful tree planting made early in the 1930's by Jim Legg, who has been a resident of the valley since 1904, and was practicing conservation long before he helped organize the Cody district in 1947. During his more than 16 years as a district cooperator and supervisor, he has seen a lot of good conservation work applied on his own ranch and elsewhere in the valley, but he says no conservation measure has given him more satisfaction than the windbreak which now protects his home.

Legg shows off windbreak planted in 1932.

It was after Legg lost his barn roof for the second time, in 1932, that he decided to plant the windbreak. He obtained a supply of tree seedlings from the county Extension agent, read everything he could find on windbreaks, and used his own judgment in developing a planting plan.

He knew it would take a sizable windbreak to slow down the high valley winds. He also wanted the windbreak far enough from his buildings so winter snows would not cause trouble.

He set out 10 rows of trees covering approximately 3 acres, using cottonwood, blue spruce, green ash, boxelder, Northwest poplar, laurel leaf, willow, and Caragana. The rows were spaced 15 feet apart, with the adjacent second and third rows of spruce 20 feet apart; and all the trees were spaced 10 feet apart in the rows except the spruce at 20 feet. The first windbreak row was planted 100 feet from the buildings, to allow ample room for more than 5 feet of snow accumulation for about 25 feet on the leeward side of the windbreak. For the first 5 years a 4-foot-wide strip close to the trees was kept clean by cultivation, to eliminate competition for moisture by weeds; livestock was kept away from the trees, and bud worms on the spruce trees and aphids on the cottonwoods had to be controlled.

The author is soil conservationist, Soil Conservation Service, Cody, Wyo.

Windbreak trees bent over by 75 m.p.h. valley winds.

The spruce trees that now tower more than 50 feet high on the north side of his home show how Legg has thrived. More important, as he says:

"When you enter the windbreak area from the valley road it is like stepping indoors. In fact, from the house, you have to look far out into the valley to tell if the wind is blowing."

Grass Seed Cost

When you buy grass seed, look at the label. Multiply the percentage of pure seed by the percentage of germination (it's all on there) and divide by 100. Divide this into the cost per pound. This tells you what pure live seed, the kind that makes grass plants, costs. You'll likely find a mixture that costs more per pound is cheaper in terms of live grass stand.

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LAND FOR AMERICANS. By Marion Clawson. 141 pp. 1963. Rand McNally & Co., Chicago. $2.25.

"Trends, prospects, and problems" is the subtitle of this popular condensation of *Land for the Future*, the thoroughgoing study for Resources for the Future by Clawson, R. Burnell Held, and Charles H. Stoddard.

The sober facts of that report are presented here in brief and sprightly fashion intended to appeal to the general reader. Issuance as a paperback in the Policy Background Series makes it easily available to a wide audience.

The scope and plan of the smaller book are similar to those of its source. Its thesis and conclusions are the same.

Today, the average American has the products and services of 12½ acres of land. His father in 1920 had about 22 acres; his son in 2000 will have perhaps 7½.

So the author epitomizes the trend of land supply in this country. How this affects land use today and in the future is the subject of the book.

The several land uses are considered in an order calculated to emphasize new problems and values. First comes "land to live on", or urban land, and then land for recreation. After these, the classic concerns of cropland, forests, and pasture are evaluated.

Private citizens, public discussion groups, and educators all will find subject matter for serious thinking in this compact volume.

—B.O.

OUR NATURAL RESOURCES. Second Edition. By P. E. McNall. 280 pp. illus. 1964. The Interstate Printers and Publishers, Inc., Danville, Ill. $4.75.

This attractive cloth-bound book is a revision of a 1954 edition that has been widely used as a high school text and library reference on conservation. Style of presentation and 111 photographs, maps, and charts make it suitable for use at the junior high school level.

The 23 chapters provide a brief survey of natural resources, their current status, conservation problems and needs, and the Nation's future requirements. The introductory chapters deal with the meaning and purpose of conservation, what natural resources are, and their use by man for better living.

Five chapters concern the power and energy resources—coal, oil and gas, the atom, sun and tides, wind and water — with emphasis on water for industrial and private use. The revised 30-page chapter on minerals has a brief new section on plant life, minerals, and commercial fertilizers. Several other chapters have been expanded; statistical data in all have been updated.

Although the statistical content of the eight chapters dealing with soil information, land-use problems, erosion, and conservation measures was brought up to date, little was done to modernize terminology. Forest and wildlife resources and their management are discussed in connection with good land use.

Those who like to explore additional references on conservation and resource use will miss the bibliography that was a part of the first edition.

The author again hopefully concludes the book with a statement for our natural resources and welfare: "Some progress has been made in changing our thinking from ways of exploitation to ways of conservation, and when the young people of the nation become completely alert to this necessity, we can rest assured that these resources will not be wastefully used."

—Adrian C. Fox

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SOIL CONSERVATION

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August 1963 to July 1964

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